REMARKS/ARGUMENTS

Claims 1, 2, 4-7 and 9-20 are pending in the application. These claims are currently rejected. Applicants submit that the foregoing amendments place the claims in condition for allowance.

Applicants' Invention

Applicants' invention is related to a method for improving throughput in continuous electrodialysis processes. In at least one embodiment, the method comprises automatically controlling the pH of acid loop solutions in strong acid/weak base configurations and of base-loop solutions in weak acid/strong base configurations by *directly* adding chemical species to ED solutions to form buffer. Thus, the solutions are maintained at a constant pH, within one pH unit. The pH can be neutral, acidic, or basic, depending on the process chemistry. Support for this constant pH limitation is found on page 9, line 19. The neutrality limitation is found on page 10, line 1, and line 26. The one pH variance limitation is found on page 13, lines 24-25.

Butterworth does not disclose regeneration of buffer external to ED stack

Claims 14-20 stand rejected under 35 U.S.C. §102(b) as being anticipated, or in the alternative under 35 U.S.C. 103(a) as obvious over Butterworth, U.S. Patent No. 5,207,879 (hereinafter *"Butterworth"*). Applicants disagree. Butterworth's "buffer" is nothing more than a physical barrier 26 which prevents chloride from contaminating the ultrapure NaOH solution Butterworth seeks to create.

Assuming *in arguendo* that sulfuric acid contained on the otherside of Butterworth's barrier 26 is construed as a buffer, then Butterworth teaches away from external regeneration of its "buffer" as claimed by the Applicants.

For example, column 3, lines 37-48 of Butterworth states in pertinent part as follows:

> "Importantly, the quantity of sulfuric acid *remains essentially constant* (emphasis mine) because substantially equal numbers of hydrogen ions enter and leave the second channel 28."

This feature of Butterworth teaches self regeneration of its "buffer" within the stack. As such, this feature of Butterworth teaches away from the claimed limitation of a constant, *external* regeneration of Applicant's buffer.

Separately, Butterworth's "buffer" does not directly and physically mix with the acid loop and or base loop as is claimed in the instant process to <u>neutralize any acid or base formed therein </u>as now claimed. Instead, it is physically isolated in a "fourth compartment" (designated as element 28) containing sulfuric acid. Specifically, Butterworth's acid loop is compartment 32, which contains hydrochloric acid. Butterworth's "buffer" (i.e. sulfuric acid) is physically separated from Butterworth's acid loop by anion membrane 26.

Butterworth does not anticipate or suggest the use of a buffer. Butterworth does not anticipate or suggest mixing buffer directly with acid/base loop solutions to <u>neutralize</u> those solutions. Butterworth does not anticipate or suggest replenishing a buffer external of an electrodialysis stack. This is because the objective of Butterworth is to keep chloride ions from contaminating sodium hydroxide product. Butterworth's objective is the production of pure sodium hydroxide (i.e., extremely high pH) to regenerate anion-exchange resins (see Col 1, lines 55-60).

Applicant's objective is high ED throughput by generating fluids having near neutral pH so as to minimize chemical insult to ED componentry.

In light of the foregoing, Applicants request withdrawal of the §§102 and 103 rejections based on Butterworth.

**<u>Mani does not anticipate
Or suggest Buffers</u>**

Claims 1-2, 4-7, 9-20-20 stand rejected under 35 U.S.C. §102(b) as being anticipated by, or in the alternative under 35 U.S.C. §103(a) as being suggested by Mani, U.S. Patent No. 6,627,016 (hereinafter "*Mani*"). The Official Action states that the addition of neutralizing agents would inherently form the buffer as claimed. Applicants disagree. Mani simply does not employ a buffer. Rather, Mani uses nanofiltration and ion-exchange to control chemistry, to wit:

> "Monovalent selective cation membranes may be used to effect preferential treatment of the monovalent cations to the base loop."
> Abstract

If Mani used a buffer, then the wide pH swings it touts (Column 12, lines 1-3) would not occur. As noted supra, buffers eliminate pH swings, or at the least, relegate the swings to within one or two units. (See Dillard and Goldberg's Chemistry, 2nd Edition, Macmillan Publishing Co, Inc, New York, 1978, p 181 attached hereto), which states in pertinent part, the following:

> "A buffer solution scarcely changes its pH even when relatively large quantities of strong acid or base or added to it. The pH changes only slightly because the week acid present reacts with any added base or the weak base present reacts with any added acid."

As stated on page 4, lines 26-30 of Applicant's own specification, Mani simply neutralizes a base with an acid. It is not a process designed to protect ED components from highly acidic or highly alkaline fluids. In fact, Mani uses strong acid to neutralize strong base. No weak acids/weak bases, which are necessary buffer components, are utilized in Mani. Mani's process teaches away from the moderate pH variation process as now claimed.

In light of the foregoing, Applicants request removal of Mani as a §102 and §103 reference and allowance of claims 1, 2, 4-7, and 9-20.

An earnest attempt has been made hereby to respond to the November 7, 2006 Official Action in this matter. The amendments to the claims are deemed to place the application in condition for allowance. If the Examiner feels that a telephonic interview will expedite allowance, he is respectfully urged to contact the undersigned. Allowance of all pending claims is respectfully solicited.

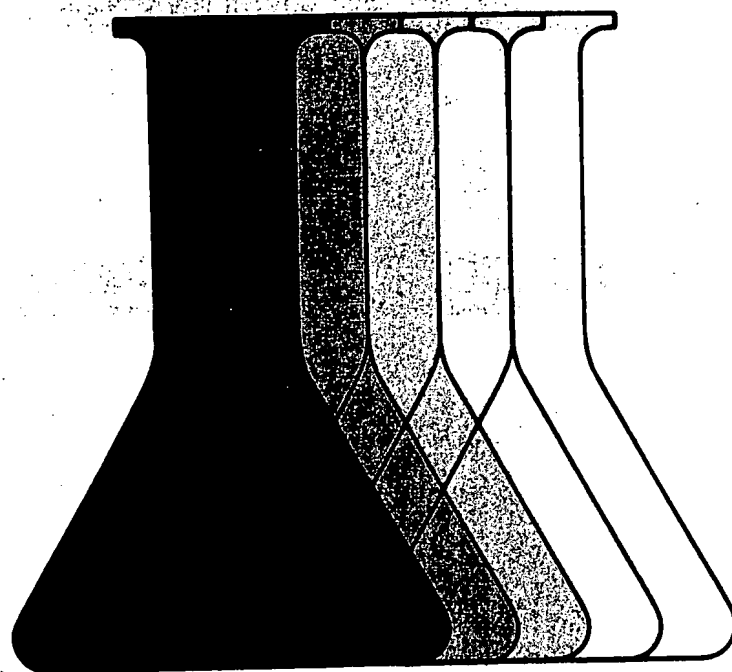Dated: April 9, 2007

Respectfully submitted,

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CHEMISTRY
Reactions, Structure, and Properties

SECOND EDITION

CLYDE R. DILLARD · DAVID E. GOLDBERG
Brooklyn College of The City University of New York

iii

Example

Calculate the pH of a solution which results from the mixing of 50.0 ml of 0.300 M HCl with 50.0 ml of 0.400 M NH$_3$.

The simplest approach to this problem is to consider that the reaction

$$NH_3 + HCl \rightarrow NH_4^+ + Cl^-$$
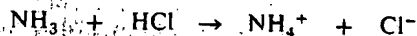
goes to completion (see exercise 57, Chapter 2). The concentrations of all the species which would be present after that reaction are then calculated and used as the initial concentrations for the equilibrium reaction. In this case, on mixing, 15.0 mmole of NH$_4^+$ is produced and 5.0 mmole of NH$_3$ remains unreacted, in a total of 100.0 ml of solution. This solution is the same as that of a solution containing 0.050 M NH$_3$ and 0.150 M NH$_4^+$. The equilibrium for the ionization of the base is now considered:

$$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$$
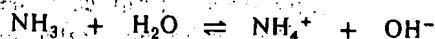
$$K_b = \frac{[NH_4^+][OH^-]}{[NH_3]} = 1.8 \times 10^{-5}$$

Let $[OH^-] = x$

$$[NH_4^+] = x + 0.150 \cong 0.150$$

$$[NH_3] = 0.050 - x \cong 0.050$$

$$K_b = \frac{(0.150)(x)}{0.050} = 1.8 \times 10^{-5}$$
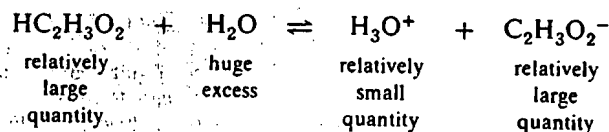
$$x = 6.0 \times 10^{-6} = [OH^-]$$

$$pOH = -(0.78 - 6) = 5.22$$

$$pH = 14.00 - pOH = 8.78$$

7-8 Buffer Solutions

A solution containing a mixture of a weak acid and its salt (conjugate base) or a weak base and its salt (conjugate acid) is called a **buffer solution**.

A buffer solution scarcely changes its pH even when relatively large quantities of strong acid or base are added to it. The pH changes only slightly because the weak acid present reacts with any added base or the weak base present reacts with any added acid. For example, consider a solution which contains a mixture of acetic acid and sodium acetate. Because of the common ion effect, the hydronium ion concentration of the solution is lower than that expected for acetic acid alone in solution. The condition at equilibrium is as follows:

$$HC_2H_3O_2 + H_2O \rightleftharpoons H_3O^+ + C_2H_3O_2^-$$

| relatively large quantity | huge excess | relatively small quantity | relatively large quantity |

If a strong acid is added to the buffer solution, the added hydronium ion reacts with the excess acetate ion present, and undissociated acetic acid is formed. If a strong base is added, the hydroxide ions of the base react with the hydronium ions present to